

**MONOLITHIC CLOCK GENERATOR AND
TIMING/FREQUENCY REFERENCE**

FIELD OF THE INVENTION

5 The present invention, in general, relates to oscillation or clocking signal generation, and more particularly, relates to a clock signal generator and timing/frequency reference which is free-running, self-referenced, accurate over fabrication process, voltage and temperature, has low jitter, and which may be monolithically integrated with other circuitry to form a single integrated circuit.

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BACKGROUND OF THE INVENTION

15 Accurate clock generators or timing references have generally relied upon crystal oscillators, such as quartz oscillators, which provide a mechanical, resonant vibration at a particular frequency. The difficulty with such crystal oscillators is that they cannot be fabricated as part of the same integrated circuit ("IC") driven by their clock signal. For example, microprocessors such as the Intel Pentium processor require a separate clock IC. As a consequence, virtually every circuit requiring an accurate clock signal requires an off-chip clock generator.

20 There are several consequences for such non-integrated solutions. For example, because such a processor must be connected through outside circuitry (such as on a printed circuit board (PCB)), power dissipation is comparatively increased. In applications which rely on a finite power supply, such as battery power in mobile communications, such additional power dissipation is detrimental.

25 In addition, such non-integrated solutions, by requiring an additional IC, increase space and area requirements, whether on the PCB or within the finished product, which is also detrimental in mobile environments. Moreover, such additional components increase manufacturing and production costs, as an additional IC must be fabricated and assembled with the primary circuitry (such as a microprocessor).

30 Other clock generators which have been produced as integrated circuits with other circuits are generally not very accurate, particularly over fabrication process, voltage, and temperature ("PVT") variations. For example, ring, relaxation and phase shift oscillators may provide a clock signal suitable for some low-sensitivity

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